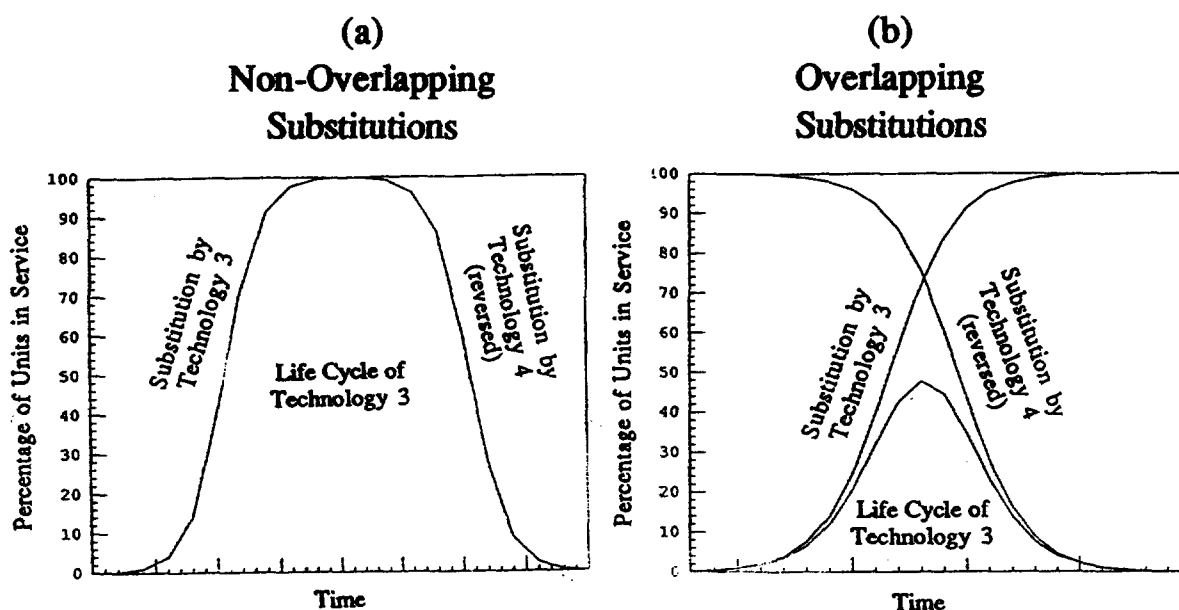


overlap, i.e., the first substitution is complete before the second begins. This situation is now rare in the electronics, computer, and telephone industries, where new technologies come on the heels of one another. For overlapping substitutions, the connection between the S-shaped substitution curves and the lifecycles is more complicated as indicated in Figure 5b.<sup>5</sup>

Figure 5  
Fisher-Pry and Life Cycles



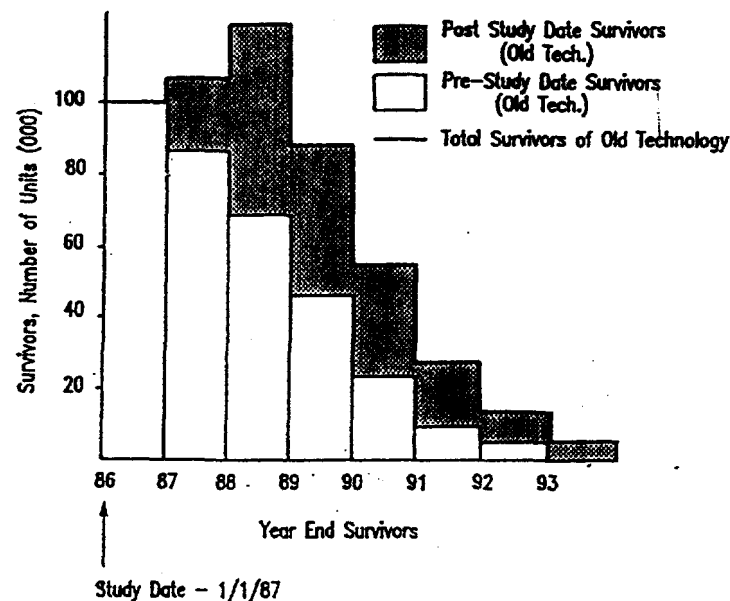
### Forecasting Depreciation Lives

Fisher-Pry substitution analysis can be used to forecast end dates for an old technology, which can then be incorporated into a standard depreciation analysis. Fisher-Pry can also be used to help derive the survivor curve from which the average remaining life (ARL) of the old technology can be calculated. This process involves several steps. First, the forecast must be stated in terms of the units of old technology as discussed above. This curve includes all survivors of the old technology, while the survivor curve applies

<sup>5</sup> A more detailed explanation is given in Appendix A of L. K. Vanston, B. R. Kravitz, and R. C. Lenz, *Average Projection Lives of Digital Switching and Circuit Equipment*, (Austin, TX: Technology Futures, Inc., 1992).

only to equipment in place as of the study date. Thus, to obtain the survivor curve, we must subtract the additions of the old technology that are added after the study date, as well as equipment retired due to normal mortality as illustrated in Figure 6.<sup>6</sup>

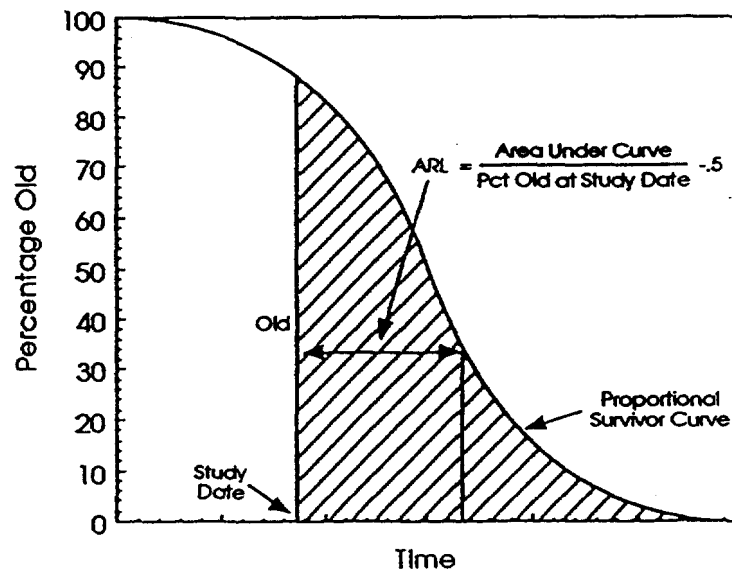
Figure 6  
Computing the Survivor Curve



For general studies, a reasonable estimate of ARL can be obtained by using the proportional curve directly, as illustrated in Figure 7. Neglecting growth may cause the ARL to be underestimated by about a year, while neglecting retirements due to normal retirements can cause the ARL to be overestimated by about as much. These factors tend to balance each other and, thus, forecasters get a good estimate unless the growth rate is extremely high or normal retirements are especially low.

<sup>6</sup> For more details see TechOver™ manual (Austin, TX: Technology Futures, Inc., 1987), pp. 8.1-8.10.

**Figure 7**  
**Estimating the Average Remaining Life**  
**from the Old Technology Market Share**



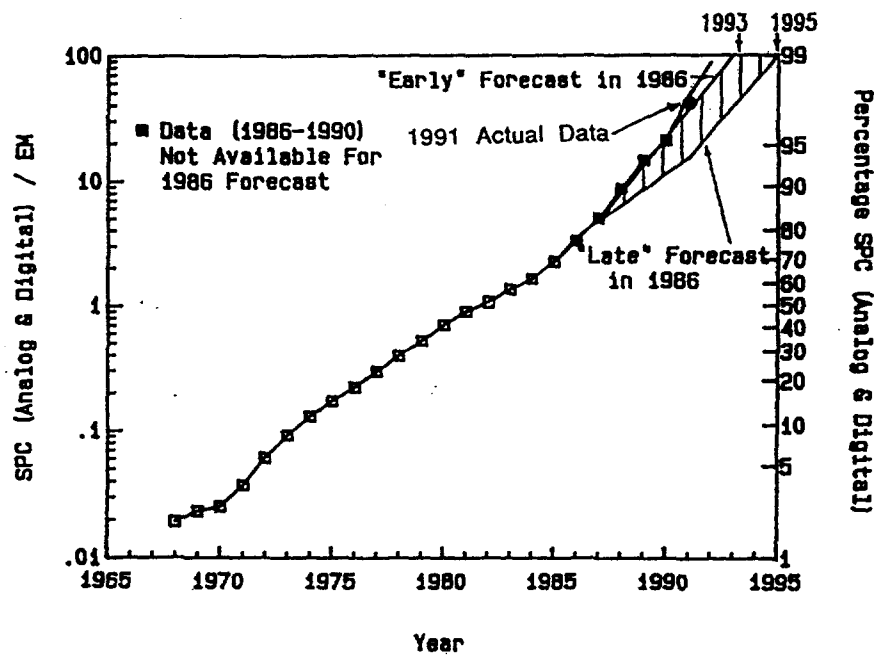
### Company Forecasts

Substitution analysis can be applied to both an individual company's data or to industry data. Naturally, industry data, spread over a larger population, tends to produce smoother curves. Also, individual companies may lag the industry substitution, but toward the end of the substitution, they tend to increase their rate of substitution and catch up with the industry. This has the effect of causing the entire industry to have essentially the same end-date and keeps the industry on the Fisher-Pry curve.<sup>7</sup> This observation is not surprising, since a company cannot stay competitive (or in business) if it fails to keep up with its competitors in the adoption of more efficient technology.

<sup>7</sup> R. C. Lenz and L. K. Vanston, *The Effects of Various Levels of Aggregation in Technology Substitutions* (Austin, TX: Technology Futures, Inc., 1987).

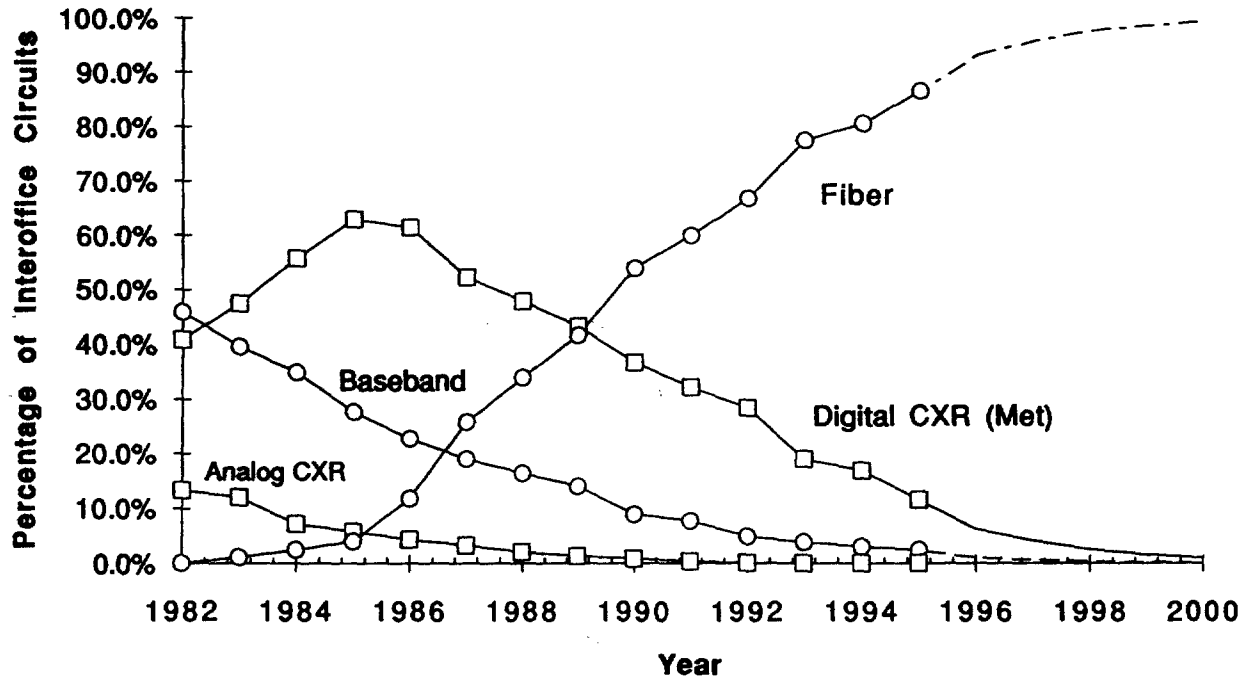
Exhibit 4

Electromechanical Switching Forecasts



Source: Technology Futures, Inc.

**Exhibit 5**  
**Interoffice Technology Shares**



## Interoffice Technology Shares

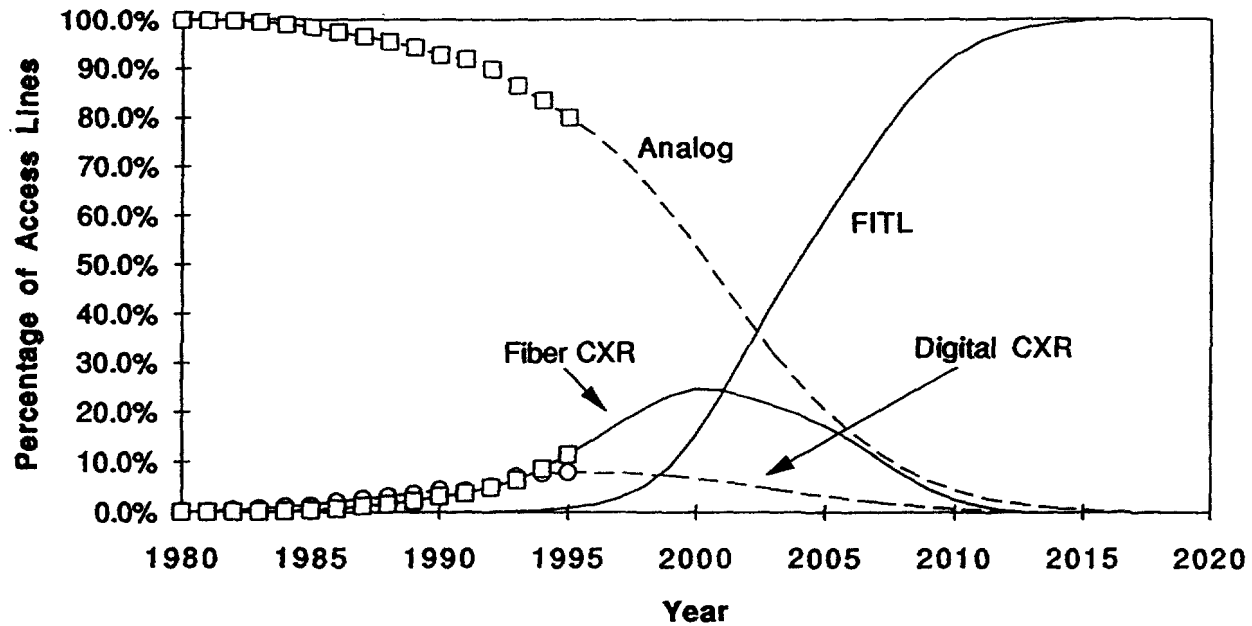
All data is stated as the percentage of total circuits.

\* Metallic CXR includes a small percentage of digital radio

<u>Year</u>	<u>Baseband Total</u>	<u>Analog CXR</u>	<u>Digital Total</u>	<u>Metallic CXR*</u>	<u>Fiber CXR</u>	
1982	45.9%	13.3%	40.8%	40.8%	0.0%	Hist
1983	39.5%	11.9%	48.5%	47.4%	1.1%	Hist
1984	34.8%	7.1%	58.1%	55.7%	2.4%	Hist
1985	27.6%	5.7%	66.7%	62.8%	3.9%	Hist
1986	22.6%	4.3%	73.0%	61.3%	11.7%	Hist
1987	18.9%	3.2%	77.9%	52.1%	25.8%	Hist
1988	16.3%	2.1%	81.6%	47.8%	33.8%	Hist
1989	14.0%	1.4%	84.7%	43.1%	41.6%	Hist
1990	8.9%	0.9%	90.3%	36.6%	53.7%	Hist
1991	7.7%	0.4%	91.8%	32.1%	59.8%	Hist
1992	4.9%	0.2%	94.9%	28.4%	66.6%	Hist
1993	3.8%	0.1%	96.1%	18.9%	77.2%	Plan
1994	3.0%	0.0%	97.0%	16.8%	80.2%	Plan
1995	2.4%	0.0%	97.6%	11.5%	86.1%	Plan
1996	1.0%	0.0%	99.0%	6.2%	92.8%	
1997	0.6%	0.0%	99.4%	4.0%	95.3%	
1998	0.4%	0.0%	99.6%	2.6%	97.0%	
1999	0.2%	0.0%	99.8%	1.6%	98.1%	
2000	0.2%	0.0%	99.8%	1.0%	98.8%	

### Exhibit 6

#### Feeder Technologies—Percentage of Access Lines



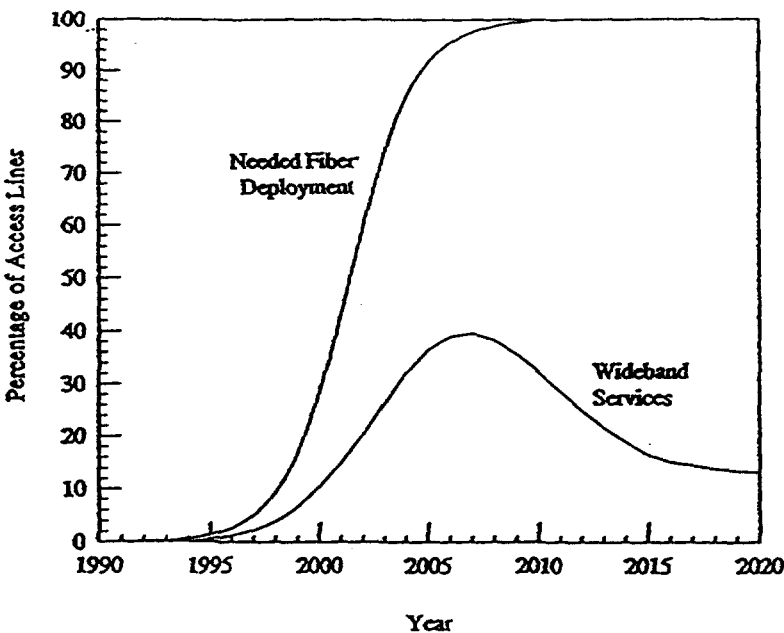
### Feeder Technologies—Percentage of Access Lines

All data is stated as the percentage of total access lines.

<u>Year</u>	<u>Analog Total</u>	<u>Digital Total</u>	<u>Digital C&amp;R</u>	<u>Fiber C&amp;R</u>	<u>FITL Total</u>	<u>Fiber Total</u>	
1980	99.9%	0.1%	0.1%	0.0%	0.0%	0.0%	Hist
1981	99.8%	0.2%	0.2%	0.0%	0.0%	0.0%	Hist
1982	99.6%	0.4%	0.4%	0.0%	0.0%	0.0%	Hist
1983	99.3%	0.7%	0.7%	0.1%	0.0%	0.1%	Hist
1984	98.8%	1.2%	1.1%	0.1%	0.0%	0.1%	Hist
1985	98.3%	1.7%	1.4%	0.4%	0.0%	0.4%	Hist
1986	97.3%	2.7%	2.0%	0.7%	0.0%	0.7%	Hist
1987	96.3%	3.7%	2.6%	1.1%	0.0%	1.1%	Hist
1988	95.3%	4.7%	3.1%	1.6%	0.0%	1.6%	Hist
1989	94.2%	5.8%	3.6%	2.2%	0.0%	2.2%	Hist
1990	92.5%	7.5%	4.4%	3.1%	0.0%	3.1%	Hist
1991	91.8%	8.2%	4.4%	3.8%	0.0%	3.8%	Hist
1992	89.7%	10.3%	5.2%	5.0%	0.1%	5.1%	Hist
1993	86.3%	13.7%	7.1%	6.3%	0.2%	6.6%	Plan
1994	83.3%	16.7%	7.7%	8.6%	0.4%	9.0%	Plan
1995	79.9%	20.1%	7.9%	11.4%	0.8%	12.2%	Plan
1996	76.3%	23.7%	7.9%	14.3%	1.5%	15.8%	
1997	71.8%	28.2%	7.8%	17.6%	2.8%	20.4%	
1998	66.5%	33.5%	7.6%	20.8%	5.2%	25.9%	
1999	60.3%	39.7%	7.3%	23.3%	9.1%	32.5%	
2000	53.3%	46.7%	6.8%	24.6%	15.3%	39.9%	
2001	46.0%	54.0%	6.1%	24.3%	23.6%	47.9%	
2002	38.6%	61.4%	5.4%	23.0%	33.1%	56.1%	
2003	31.8%	68.2%	4.6%	21.2%	42.4%	63.6%	
2004	25.7%	74.3%	3.9%	19.4%	51.0%	70.4%	
2005	20.5%	79.5%	3.3%	17.2%	59.0%	76.2%	
2006	16.0%	84.0%	2.6%	14.4%	67.1%	81.4%	
2007	12.1%	87.9%	2.0%	11.0%	75.0%	85.9%	
2008	8.8%	91.2%	1.4%	7.5%	82.2%	89.8%	
2009	6.3%	93.7%	0.9%	4.6%	88.2%	92.8%	
2010	4.4%	95.6%	0.6%	2.5%	92.5%	95.0%	
2011	3.0%	97.0%	0.4%	1.2%	95.4%	96.6%	
2012	2.1%	97.9%	0.2%	0.4%	97.3%	97.7%	
2013	1.4%	98.6%	0.1%	0.0%	98.4%	98.4%	
2014	0.9%	99.1%	0.1%	0.0%	99.1%	99.1%	
2015	0.5%	99.5%	0.0%	0.0%	99.5%	99.5%	

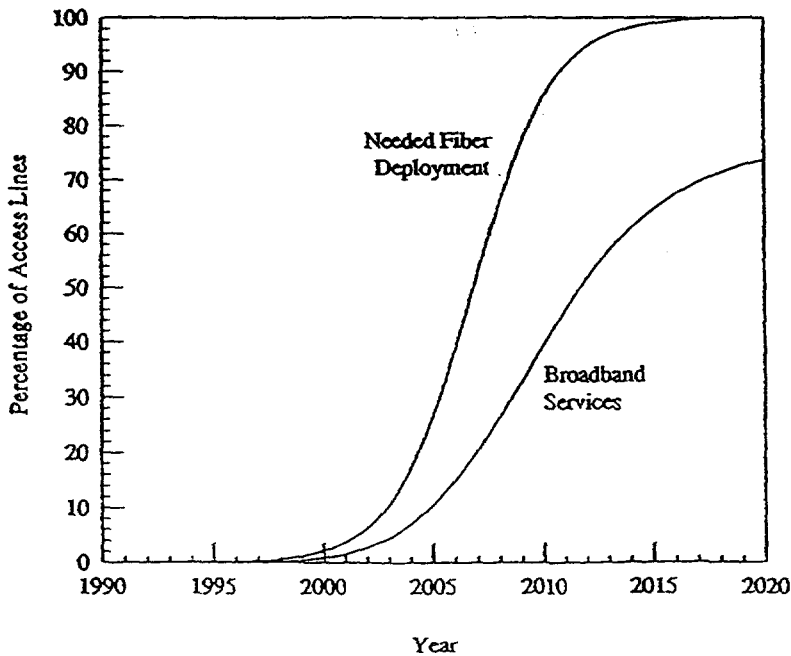
Exhibit 7

The Deployment of Fiber in the Loop to Meet New Services Demand



Source: Technology Futures, Inc.

Fiber for Broadband Services



Source: Technology Futures, Inc.

## Exhibit 8

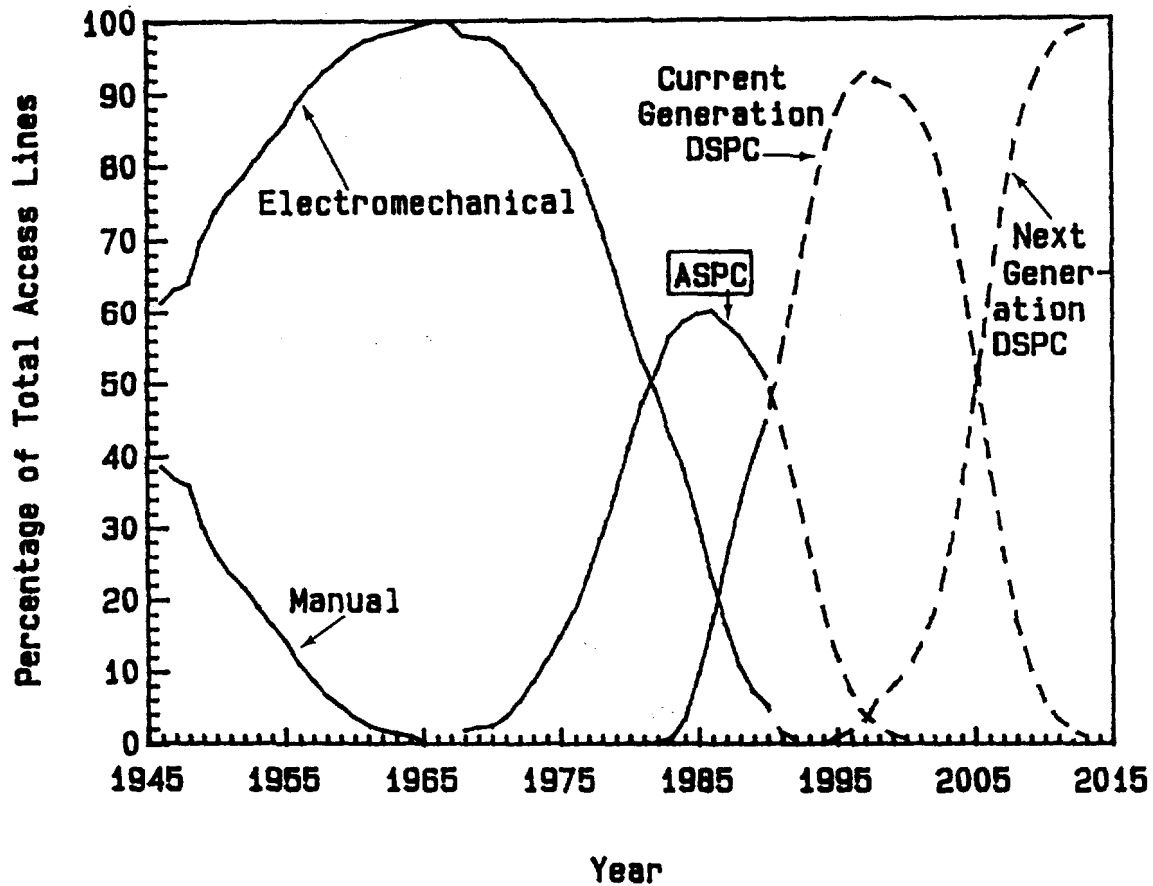
**The Deployment of Fiber in the Loop and  
Percentage Survivor Curves for Copper Distribution Facilities**

Year	Fiber for Wideband Deployment			Fiber for Broadband Deployment			Average Scenario		
	Pct of Access Lines		Pct of Copper Lines Surviving	Pct of Access Lines		Pct of Copper Lines Surviving	Pct of Access Lines		Pct of Copper Lines Surviving
	Fiber	Copper		Fiber	Copper		Fiber	Copper	
1992	0.2%	99.8%	100.0%	0.0%	100.0%	100.0%	0.1%	99.9%	100.0%
1993	0.4%	99.6%	99.8%	0.0%	100.0%	100.0%	0.2%	99.8%	99.9%
1994	0.6%	99.2%	99.5%	0.1%	99.9%	99.9%	0.4%	99.6%	99.7%
1995	1.4%	98.6%	98.6%	0.1%	99.9%	99.9%	0.8%	99.2%	99.3%
1996	2.8%	97.2%	97.4%	0.2%	99.8%	99.8%	1.5%	98.5%	98.6%
1997	5.2%	94.6%	95.0%	0.4%	99.6%	99.6%	2.8%	97.2%	97.3%
1998	9.6%	90.4%	90.6%	0.7%	99.3%	99.3%	5.2%	94.8%	94.9%
1999	17.0%	83.0%	83.2%	1.3%	98.7%	98.7%	9.1%	90.9%	91.0%
2000	28.4%	71.6%	71.7%	2.2%	97.8%	97.8%	15.3%	84.7%	84.8%
2001	43.4%	56.6%	56.7%	3.8%	96.2%	96.2%	23.6%	76.4%	76.5%
2002	58.8%	40.2%	40.3%	6.4%	93.6%	93.6%	33.1%	66.9%	67.0%
2003	74.2%	25.8%	25.9%	10.7%	88.3%	88.4%	42.4%	57.6%	57.6%
2004	84.6%	15.2%	15.3%	17.2%	82.6%	82.6%	51.0%	49.0%	49.1%
2005	91.5%	8.5%	8.5%	26.6%	73.4%	73.4%	59.0%	41.0%	41.0%
2006	95.4%	4.6%	4.6%	36.7%	61.3%	61.3%	67.1%	32.9%	33.0%
2007	97.6%	2.4%	2.4%	52.4%	47.6%	47.6%	75.0%	25.0%	25.0%
2008	98.7%	1.3%	1.3%	65.7%	34.3%	34.3%	82.2%	17.8%	17.8%
2009	99.3%	0.7%	0.7%	77.0%	23.0%	23.0%	88.2%	11.8%	11.9%
2010				85.3%	14.7%	14.7%	92.5%	7.5%	7.5%
2011				91.0%	9.0%	9.0%	95.4%	4.6%	4.6%
2012				94.6%	5.4%	5.4%	97.3%	2.7%	2.7%
2013				96.9%	3.1%	3.1%	98.4%	1.6%	1.6%
2014				98.2%	1.8%	1.8%	99.1%	0.9%	0.9%
2015				98.9%	1.1%	1.1%			
2016				99.4%	0.6%	0.6%			
	Avg Remaining Life (as of 1/1/93)		9.4	Avg Remaining Life (as of 1/1/93)		14.8	Avg Remaining Life (as of 1/1/93)		12.1

Source: Technology Futures, Inc.

### Exhibit 9

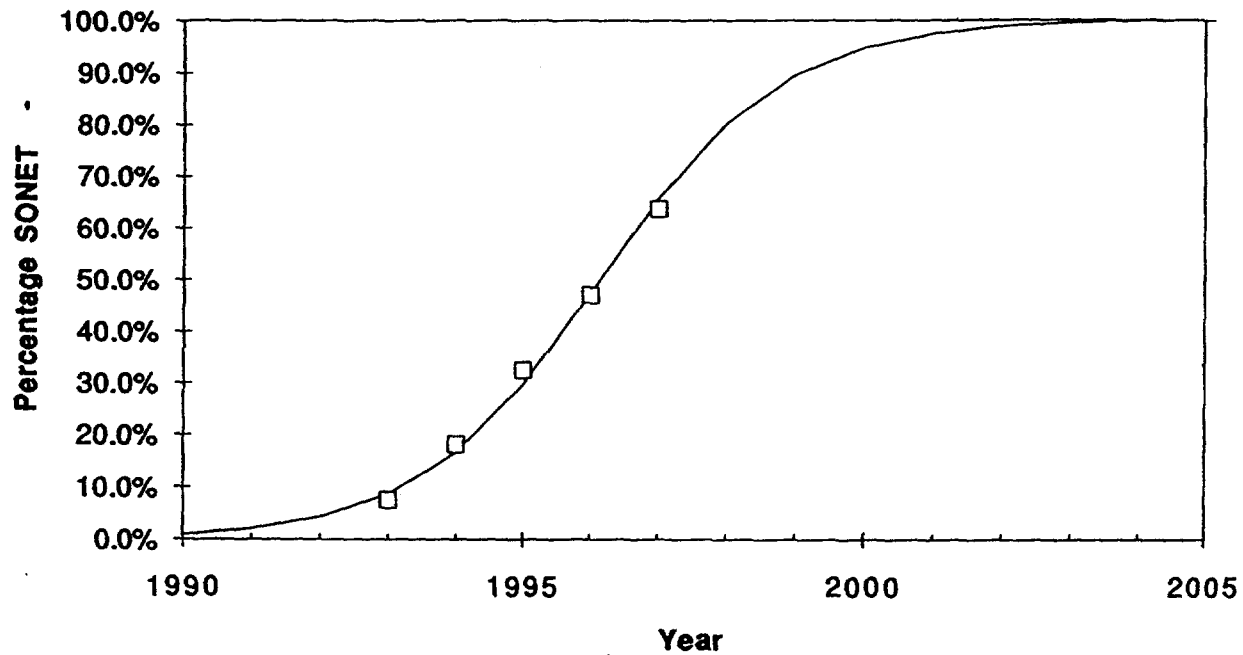
#### Percentage of Access Lines Served by Successive Switching Technologies—1946-2015



Source: Technology Futures, Inc.

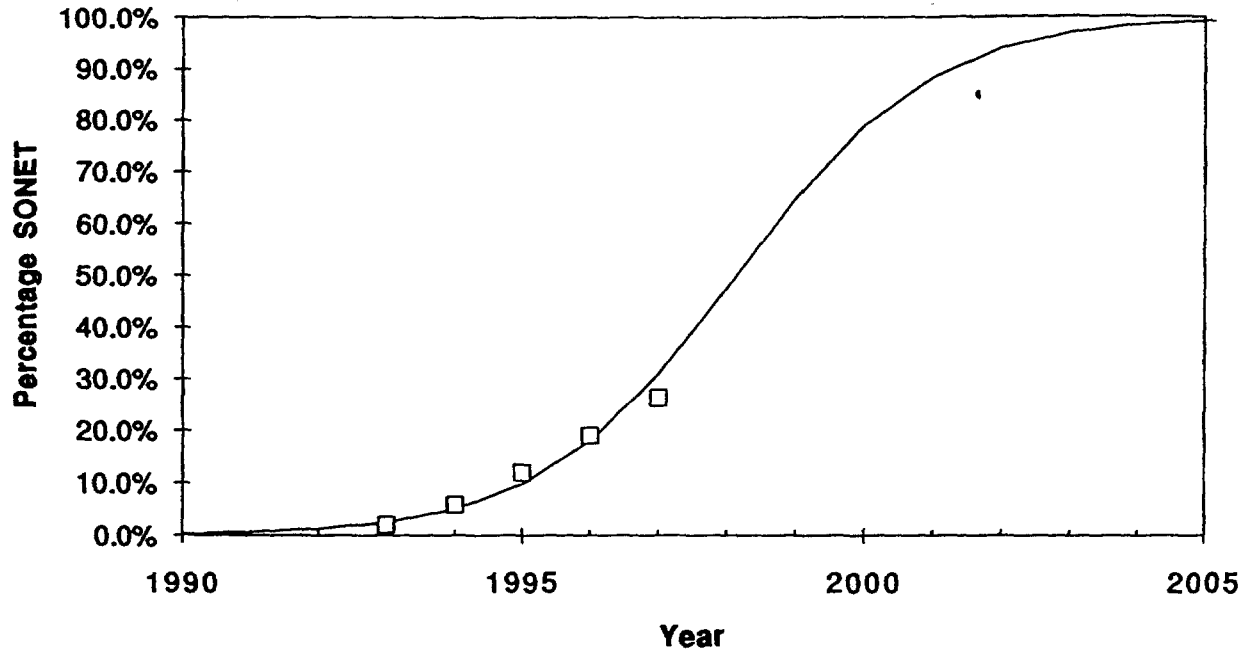
ASPC = Analog Stored Program Control

DSPC = Digital Stored Program Control

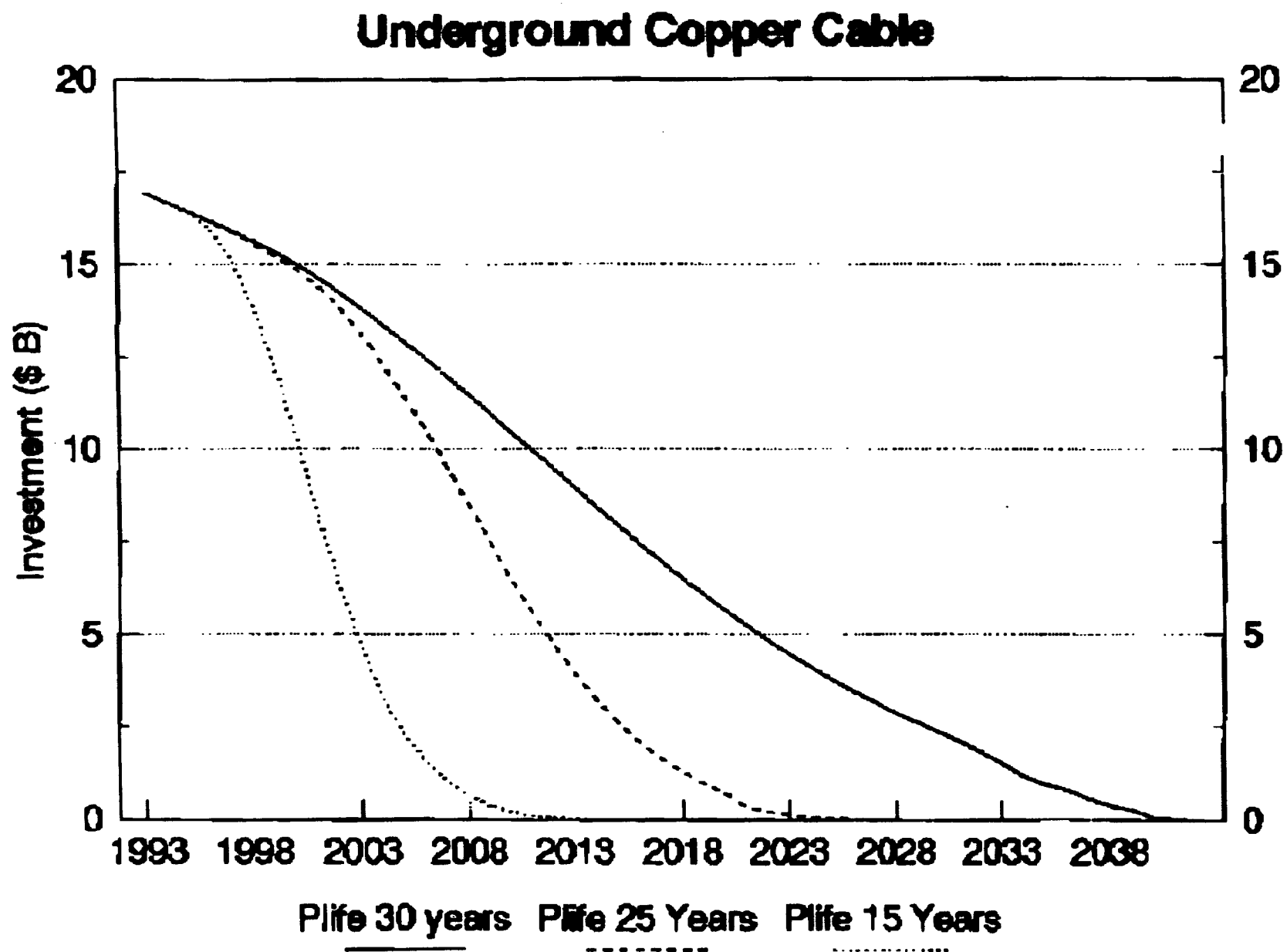
**Exhibit 10****Interoffice SONET Equipment—Percentage of Capacity**

<u>Year</u>	<u>Pct</u> <u>Non-SONET</u>	<u>Pct</u> <u>SONET</u>	<u>Comments</u>
1990			
1991			
1992			
1993	92.5%	7.5%	Planned
1994	81.9%	18.1%	Planned
1995	67.6%	32.4%	Planned
1996	53.1%	46.9%	Planned
1997	36.4%	63.6%	Planned
1998	19.9%	80.1%	
1999	10.4%	89.6%	
2000	5.2%	94.8%	
2001	2.5%	97.5%	
2002	1.2%	98.8%	
2003	0.6%	99.4%	
2004	0.3%	99.7%	
2005	0.1%	99.9%	

## Feeder SONET Equipment—Percentage of Capacity

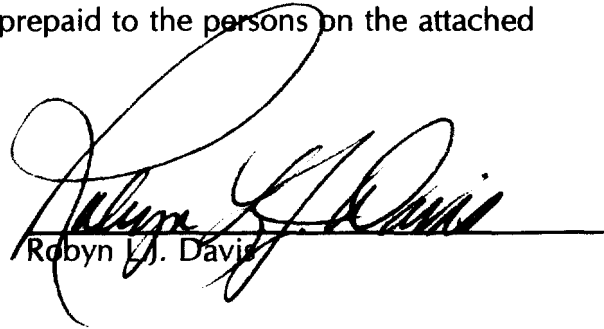


<u>Year</u>	<u>Pct</u> <u>Non-SONET</u>	<u>Pct</u> <u>SONET</u>	<u>Comments</u>
1990			
1991			
1992			
1993	98.0%	2.0%	Planned
1994	94.2%	5.8%	Planned
1995	88.1%	11.9%	Planned
1996	81.0%	19.0%	Planned
1997	73.8%	26.2%	Planned
1998	52.8%	47.2%	
1999	35.5%	64.5%	
2000	21.3%	78.7%	
2001	11.8%	88.2%	
2002	6.2%	93.8%	
2003	3.1%	96.9%	
2004	1.6%	98.4%	
2005	0.8%	99.2%	
2006	0.4%	99.6%	
2007	0.2%	99.8%	
2008	0.1%	99.9%	
2009	0.0%	100.0%	
2010	0.0%	100.0%	



**CERTIFICATE OF SERVICE**

I, Robyn L.J. Davis, do certify that on December 17, 1993 copies of the Comments of the United States Telephone Association were either hand-delivered, or deposited in the U.S. Mail, first-class, postage prepaid to the persons on the attached service list.



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